

Claims

What is claimed is:

1. A battery charger comprising:
 - a variable alternating-current power supply configured to output a first alternating current of a controllable power level;
 - a digital controller configured to control said power supply, the control including at least control of the power level of the first alternating current;
 - a foil-type first transformer configured to change the voltage of the first alternating current to a second alternating current; and
 - a rectifier configured to convert the second alternating current to a direct current.
2. The battery charger of claim 1, said power supply being a variable-frequency generator and said digital controller being configured to control the frequency of said first alternating current.
3. The battery charger of claim 1, said charger being configured to charge at a plurality of direct-current output voltages.
4. The battery charger of claim 3, the charger being configured to automatically determine the voltage of the battery and supply the correct output voltage and current.
5. The battery charger of claim 1, said charger being configured to charge at up to about 100 amps.
6. The battery charger of claim 1, said charger being configured to charge at up to about 100 volts.
7. The battery charger of claim 1, said charger further comprising a foil-type second transformer configured to supply power to said controller.
8. The battery charger of claim 1, said charger further comprising a filter configured to filter said direct-current output.
9. The battery charger of claim 1, said controller being configured to measure the voltage of said direct-current output.

10. The battery charger of claim 1, said charger being configured to enable an indication when the battery is substantially charged.
11. The battery charger of claim 1, said charger being configured to communicate with a digital diagnostic device configured to facilitate maintenance of the battery charger or diagnosis of faults.
12. The battery charger of claim 1, said power supply further comprising a rectifier.
13. The battery charger of claim 1, said first transformer being configured so that said second alternating current has a lower voltage and a higher amperage than said first alternating current.
14. The battery charger of claim 1, said first transformer having copper foil.
15. An electric-vehicle charger comprising:
 - a card reader configured to enable the charger;
 - a variable-frequency generator configured to input electrical power and output a first alternating current of a controllable frequency;
 - a digital controller configured to control said variable-frequency generator, the control including at least control of the frequency of said first alternating current;
 - a first transformer configured to change the voltage of said first alternating current to a second alternating current;
 - a rectifier configured to convert the second alternating current to a direct-current output;
 - a multi-pin connector configured to connect to an electric vehicle and deliver the direct-current output to the vehicle.
16. The electric-vehicle charger of claim 15, said first transformer being a foil-type transformer.
17. The electric-vehicle charger of claim 16, said foil substantially comprising copper.

18. The electric-vehicle charger of claim 15, said charger being configured to charge at a plurality of direct-current output voltages, the charger being configured to automatically determine the voltage of the electric vehicle and supply the correct voltage and current.
19. The electric-vehicle charger of claim 15, said charger being configured to charge at up to about 100 amps.
20. The electric-vehicle charger of claim 15, said charger being configured to charge at up to about 100 volts.
21. The electric-vehicle charger of claim 15, said charger further comprising a foil-type second transformer configured to supply power to said controller.
22. The electric-vehicle charger of claim 15, said charger further comprising a filter configured to filter said direct-current output, said filter comprising at least an inductor and a capacitor.
23. The electric-vehicle charger of claim 15, said controller being configured to measure the voltage of said direct-current output.
24. The electric-vehicle charger of claim 15, said controller being configured to enable an indication when the electric vehicle is substantially charged.
25. The electric-vehicle charger of claim 15, said charger being configured to communicate with a digital diagnostic device configured to facilitate maintenance or diagnosis of faults.
26. The electric-vehicle charger of claim 15, said first transformer being configured so that said second alternating current has a lower voltage and a higher amperage than said first alternating current; and said variable-frequency generator being configured so that said first alternating current has a substantially higher frequency than that of said input electrical power.

27. A vehicle comprising:
- a variable alternating-current power supply configured to input electrical power and output a first alternating current of a controllable power level;
 - a digital controller configured to control said power supply, the control including at least control of the power level of the first alternating current;
 - a foil-type first transformer configured to change the voltage of the first alternating current to a second alternating current;
 - a rectifier configured to convert the second alternating current to a direct current; and
 - at least one battery configured to store the direct-current output.
28. The vehicle of claim 27, said power supply being a variable-frequency generator and said digital controller being configured to control the frequency of the first alternating current.
29. The vehicle of claim 27, said electrical power being supplied from a substantially-constant voltage source external to the vehicle through a cord and a connector.

30. A method of charging at least one battery comprising at least the steps of:
- measuring the substantially open-circuit voltage of the at least one battery;
 - using the substantially open-circuit voltage, selecting a first power level for charging the at least one battery;
 - starting to charge the at least one battery at the first power level;
 - measuring the charging voltage and the charging current;
 - increasing the charging power level until at least one of a current lid and a voltage lid is exceeded, the voltage lid being based on the open-circuit voltage; and
 - charging until a current threshold is reached.
31. The method of claim 30:
- wherein the step of increasing the charging power level occurs until a current lid is exceeded;
 - further comprising the step of charging at a substantially constant current until the voltage lid is exceeded.
32. The method of claim 30 wherein the step of increasing the charging power level includes increasing a frequency.
33. The method of claim 30 further comprising a prior step of partially charging the battery.
34. The method of claim 30 wherein the step of charging until a current threshold is reached comprises charging at a substantially constant voltage.
35. The method of claim 30 wherein the voltage lid is adjusted based on a temperature of the battery.
36. The method of claim 30 further comprising the step of stopping charging when the charging current reaches the current threshold.

37. The method of claim 30, said step of increasing the charging power level comprising at least a first rate of increase and a second rate of increase, the first rate of increase occurring in time before the second rate of increase and the first rate of increase being greater than the second rate of increase.
38. The method of claim 37 wherein the change from the first rate of increase to the second rate of increase is triggered by at least one of:
- a substantial cessation of increasing of the charging voltage, and
 - the charging current exceeding a minimum value.
39. The method of claim 30 further comprising the steps of:
- stopping the charging; and
 - verifying the open-circuit voltage.
40. The method of claim 30 further comprising the steps of:
- using the substantially open-circuit voltage, estimating a charging current at a particular power level; and
 - verifying that the charging current is within acceptable parameters at a particular power level.
41. A method of charging at least one battery comprising in the following order the steps of:
- starting to charge the at least one battery at a first power level;
 - measuring a charging voltage and a charging current;
 - increasing a charging power level and a frequency until at least one of a current lid and a voltage lid is exceeded; and
 - charging substantially at the voltage lid.
42. The method of claim 41, the power being produced by a variable-frequency generator.
43. The method of claim 42, the variable-frequency generator having an alternating current output, the alternating current output being transformed with a foil-type transformer.